## REMARKS

This responds to the Office Action dated 2 September 2004. Applicant respectfully requests reconsideration of the application in view of the foregoing amendments and following remarks. New claims 8-19 have been added. Claims 1-7 have been amended to correct minor informalities and not for any reason related to patentability. The amendments to claims 1-7 are made for consistency in the use of terms. The amendments to claims 1-7 are not narrowing amendments and are not made to overcome any cited prior art. Accordingly, claims 1-19 remain pending in the application.

### Request for Information

The Examiner requested a copy of non-patent literature pertaining to the Gee and Poncet designs. Applicant notes that the Gee and Poncet designs are shown Figs. 1-2 of the cited d'Autume patent (U.S. 5,062,699), as well as in Fig. 2 of the present application. Applicant does not refer to any non-patent literature in the specification. Page 1, paragraph 3 simply names the Gee and Poncet designs (which are shown in the '699 patent) as prior art. Nevertheless, in an effort to assist the Examiner, Applicant has found and submits herewith additional literature pertaining to the Gee and Poncet designs in a supplemental information disclosure statement.

### In the Specification

The Examiner objected to the specification because the drawings include reference characters 6 (Fig. 1), 45 (Fig. 2), and 26 (Fig. 3) that are not mentioned in the

description. Applicant has amended Figs. 1-3 with two replacement sheets to overcome the objection.

The Examiner objected to the disclosure because the pages were not numbered. Applicant has included a substitute specification herewith including page numbers.

The Examiner also objected to the disclosure because the terminology lacked consistency throughout the detailed description. The substitute specification corrects the informalities.

Accordingly, Applicant respectfully requests that the objections to the specification be withdrawn.

## Claim Objections

Claims 4 and 6 were objected to for minor informalities. Claims 4 and 6 have been amended to correct the informalities and not for any reasons related to patentability. The amendments to claims 4 and 6 are not narrowing amendments.

## Response to Rejections Under 35 U.S.C. § 103

The Examiner has rejected claims 1-7 under 35 U.S.C. § 103(a) as being unpatentable over d'Autume ("the '699 patent") in view of d'Autume (*Sky and Telescope* Sept. 1988 "the d'Autume article"). The Examiner states that the '699 patent discloses all of the limitations of the claims, with the exception of a front bearing surface with contacting rolling bearing elements having fixed or varying radii segments. The Examiner also states that the '699 patent does not disclose means of adjusting angles of its rolling surfaces and contact rollers. However, the Examiner alleges that

the d'Autume article discloses a front bearing surface with fixed or varying radii. Applicant respectfully traverses the rejection.

According to MPEP §706.02(j), for a claim to be obvious, there must be a) a suggestion or motivation to combine reference teachings, b) a reasonable expectation of success, and c) the references must teach all of the claim limitations. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). The Office has failed to prove any of the three requirements for a proper obviousness rejection.

First, for a proper § 103 rejection, the references must teach all of the claim limitations. Claims 1, 4, and 6 recite "a plurality of adjustable engagement angle rolling bearing elements." For example, the specification of the present application discloses elements 4 and 8 as embodiments of rolling bearing elements that are angle-adjustable. The Examiner alleges that elements a-e of the '699 patent (Fig. 5 and col. 5, lines 1-5) disclose the "adjustable engagement angle rolling bearing elements." However, neither the '699 patent nor the d'Autume article disclose "*adjustable engagement angle* rolling bearing elements."

The '699 discloses *fixed* rollers a-e. There is no disclosure in the '699 patent of any mechanism that would enable the fixed rollers a-e to be "adjustable." As the Examiner cited, the '699 patent states that the rollers "are inclined 45°," which "had advantages," but the angle choice "is not essential." Thus, the structure taught by the '699 patent may be built with *fixed rollers* (a-e) at angles other than 45°, but there is no structure disclosed, nor anything else to suggest that the rollers are or could be "adjustable." A proper §103 rejection requires *identical disclosure* of the claimed limitations, and a comment that an angle is not necessarily required to be at the preferred orientation does not teach anything about an adjustable structure. The '699

patent actually discloses only fixed rollers, not adjustable rollers. Therefore, the Examiner has failed to make a *prima facie* case of obviousness, because neither the '699 patent nor the d'Autume article disclose an adjustable structure. Accordingly, the rejection of claims 1 and 3-7 should be withdrawn on this basis alone. However, if the Examiner persists with the §103 rejection of claims 1 and 3-7 over the '699 patent in view of the d'Autume article, in the absence of any reference showing an *adjustable* engagement angle rolling bearing element *as claimed*, Applicant requests that the Examiner submit an affidavit in accordance with 37 CFR §1.104(d)(2) substantiating the allegation. The applicant also requests opportunity to contradict the Examiner's affidavit as prescribed by the rule.

Moreover, claim 1 also recites a platform having "a front bearing surface of fixed radius and adjustable angle." The present specification discloses, for example, element 11, which is a front bearing surface of fixed radius and adjustable angle (by the hinges 32). The Examiner does not even allege that either the '699 patent or the d'Autume article discloses a front bearing surface of *adjustable angle*. Accordingly, Applicant may demur because the Examiner has not established a *prima facie* case of obviousness for claim 1. In fact neither the '699 patent nor the d'Autume article teaches or suggests a front bearing surface of adjustable angle. Therefore the rejection of claim 1 is improper. If the Examiner alleges in a subsequent Action that the cited references do disclose a front bearing surface of adjustable angle, such Action must be non-final to afford the Applicant opportunity to respond.

With regard to claim 4, the Examiner admits that neither the '699 patent nor the d'Autume article disclose a front bearing of varying radii segments. However, the Examiner argues that para. 1, p. 306 of the d'Autume article teaches that the *front*

*bearing surface* would be adjusted to different shapes for different latitudes. However, para. 1 of p. 306 actually discloses the possibility of a change to the "***surface for roller e,***" not the *front bearing surface*. The d'Autume article only teaches a "cylinder" shape for the front bearing surface and possible change to the surface of roller e. Therefore, Applicant believes that the rejection of claim 4 should be withdrawn for this additional reason.

In addition, with regard to claim 2, the Examiner admits that the '699 patent "does not expressly disclose the means of adjusting the angles of its rolling surfaces and contact rollers." However, the Examiner cites a phrase from the '699 patent stating that it is not essential that the contact rollers be inclined at 45° as evidence of "means of adjusting angles." What are these dislosed "means?" They must be shown and cited by the Examiner for a proper §103 rejection. The Applicant does not know what "means" the Examiner is referring to.

The Examiner also states that the '699 patent teaches that the adjustment angle of its contact rollers "must be allowed." Applicant respectfully disagrees. Applicant has searched the cited reference at col. 4, line 54 - col. 5, line 5, and has not found anything that would constitute a teaching that adjustment "must be allowed" or any "means" of doing so. If adjustment must be allowed, there should be some disclosure of how the adjustment could be made, otherwise the disclosure is ***not enabled***. "Means of adjusting the angles" refers to a structure capable of the recited adjustment. The '699 patent does not disclose, suggest, or enable any structure that would offer adjustability to the rollers (a-e). Again, Applicant admits that the '699 teaches that the fixed rollers of a finished product do not necessarily have to be inclined at 45°, but for a proper §103 rejection, there must be *disclosure* of some apparatus or means of ***providing adjustment***

to the structure taught, not just that a final product can have a fixed roller angle other than 45°. The Examiner points to the hinges disclosed in the present application as a means for allowing adjustment, stating that hinges are obvious. However, conspicuously missing from any of the cited reference is any actual disclosure of hinges or any other structure that would facilitate adjustment. Applicant does not claim a hinge is novel, however, the combined structure as claimed is. If the Examiner cannot cite an actual teaching from an analogous reference showing or describing a structure that facilitates adjustment as claimed, the rejection should be withdrawn. One of the primary problems mentioned in the Background of the present invention--separate surfaces that must be custom made for every latitude of operation for prior art platforms--is solved by the structure of claim 2, and not taught by the cited prior art. Therefore, if the rejection of claim 2 persists, Applicant respectfully requests that in the absence of any reference teaching a means of adjusting angles between rolling surfaces and contact rollers, the Examiner submit an affidavit, subject to traverse, in accordance with 37 CFR §1.104(d)(2) substantiating the allegation.

Second, for a proper § 103 rejection, there must be motivation and a reasonable expectation of success by the combined reference teachings to arrive at the claimed invention. Even if the rollers of the '699 patent were somehow adjustable, the bearing surfaces are not fabricated such that a change in roller angle would enable use at different latitudes. Therefore, there is no motivation or reasonable expectation of successfully arriving at the claimed invention by providing an angle-adjustable roller to the '699 patent.

New claims 8-19 also include limitations not taught or suggested by the cited references. For example, new claim 8 recites adjustable hinges, which must be

identically shown in a prior art reference, allowed, or, if rejected based on the Examiner's knowledge without a supporting reference, substantiated by an affidavit subject to traverse. In addition, claim 18 recites a rear bearing block comprising a plurality of *continuous* contours of differing radii. The '699 patent, on the other hand, discloses only discreet, discontinuous surfaces of differing radii.

Accordingly, applicant respectfully requests that the rejection of claim 1-7 under 35 U.S.C. §103(a) be withdrawn and claims 1-19 be allowed.

**Conclusion**

Applicant respectfully submits that all claims are in condition for allowance. Applicant respectfully requests the Examiner to telephone the undersigned attorney if there are unresolved matters in the present application so that the examination process can be expedited.

Respectfully submitted,

Date: 12/2/04

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Substitute Specification with markings to show changes made



Adjustable Telescope Tracking Platform

## BACKGROUND OF THE INVENTION

### ~~I.~~Field of the Invention

~~II.~~The present invention relates optical and radio telescope and satellite tracking devices which must compensate for the rotational movement of the earth in order to accurately track a celestial object.

### ~~III.~~Description of the Relevant Art

As telescopes become larger, conventional mounting systems become large, heavy, and unwieldy. Popular today are large alt-azimuth mounted telescopes of a type referred to as Dobsionan. These are incapable of automated tracking ability, unless each axis is fitted with complex motors and drive electronics. This is inconsistent with the low cost of this type of telescope. Thus, these telescopes must be moved by hand in order to ~~tack~~ track or follow an object.

In order to allow the Dobsionan telescope to track, low profile equatorial tracking tales were developed and popularized. These consist of two horizontal table like surfaces which create a virtual axis of revolution aligned with the earth's rotational axis by the creation of two or more circular or conical bearing surfaces which are truncated by the intersecting surface of the topmost horizontal table surface. The circular or conical bearing surfaces must be accurately machined and pre-fabricated to the users latitude. Designs popularized by Gee and Poncet utilize a fixed pivot point for one bearing surface, the other being a plane or circular bearing segment. The design described by George d'Autume, USP #5,062,699, necessitates a conical surface consisting of a number of tracks and rollers. However, this too is for a singly fixed latitude, and must be pre-fabricated precisely to user's exact latitude. Thus, these platforms are unable to be mass produced and inventoried for low cost, and should the user ever move or desire to use the platform at a different latitude, another complete table must be purchased, often with long lead times.

Accordingly, these prior approaches have failed to meet the need of the telescope user.

SUMMARY OF THE PRESENT INVENTION

The present invention provides for an easily adjustable motorized equatorial tracking platform onto which can be mounted a telescope or other instrument which can compensate for the rotational movement of the earth, and allow the instrument to track a celestial object with high accuracy at any desired latitude setting.
The general design comprises two rolling surfaces, each in contact with a pair of rollers which each have an adjustment for the latitude setting. One rolling surface is a complex 3-dimensional contour, which provides for a differing radius for each latitude setting, while the other rolling surface is of fixed radius, but with adjustable latitude angle. By varying the angle of the roller pairs, the virtual axis of rotation is changed to be aligned parallel to the earth's rotational axis. When one or more of the rollers are motorized, and the virtual rotational axis of the platform is aligned with the earth's rotational axis, the invention will allow a telescope to accurately track a celestial object. By positioning the telescope on the top table surface so that the telescope center of gravity aligns with the virtual rotational axis, rotational moments are minimized and very small motors can be used to drive the telescope.

A more specific design of the equatorial platform is described at length and depicted in diagrams.

The platform consists of an adjustable front truncated bearing plate surface, of sufficient radius to ensure that the virtual polar axis which passes thru it's center of curvature is located at a higher elevation than the center of gravity of the telescope placed upon it. This front bearing surface segment is cylindrical, of fixed thickness, and rides in two grooved drive rollers spaced sufficiently apart to provide lateral support stability. One or both rollers can be motorized so as to impart a rotational translation to the front bearing plate solely by friction. The front bearing plate is attached to a somewhat horizontal top platform surface by means of an adjustable hinge assembly, which can be clamped at a user defined acute angle. The motor and drive roller

assembly is carried on a motor/roller carrying plate, and is likewise adjustably hinged and clamped to a bottom horizontal base surface. This surface resides on the ground. A rear 3-dimensionally contoured bearing is spaced some defined distance from the front truncated bearing plate, and securely fastened to the underside of the top platform surface. This contoured bearing surface has machined into it a plurality of differing radii which are a function of the contact angle of a single or pair of rear support rollers, this contact angle being set by a hinged rear roller mounting bracket mounted to the bottom horizontal base surface.

For northern hemisphere installations, the front bearing surface faces north. For southern hemisphere installations, it faces south, and the drive roller rotation is reversed. In both cases, all hinge angles are adjusted to align the virtual rotational axis of the platform with the earth's rotational axis. By fine adjustments of the azimuth base position and altitude virtual axis alignment of the celestial pole, and motor speed rate, very precise tracking is possible, which will allow long exposure imaging or photography to be performed.

Other advantages and features of the present invention will become apparent from the following detailed description when read in conjunction with the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood by reference to the following detailed description of the preferred embodiments of the present invention when read in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout the views, and in which:

FIG. 1 is a perspective view of the principles necessary to understand the operation of an equatorial tracking platform.

FIG. 2 is a perspective view of an equatorial platform according to the Poncet design.

FIG. 3 is a view of the exploded family of curves of the contoured bearing surface of the present invention.

FIG. 4 is a perspective view of the rear 3-dimensional contoured bearing surface of the present invention.

FIG. 5 is a perspective view of an equatorial platform according to the inventor's design.

~~Figure~~FIGs. 6A and 6B are diagrammatic side views of the virtual polar axis angles as a function of the latitude hinge clamping angles.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE PRESENT INVENTION

The drawing describes the preferred embodiment of the present invention. While the configurations according to the illustrated embodiment are preferred, it is envisioned that alternate configurations of the present invention may be adopted without deviating from the invention as portrayed. The preferred embodiment is discussed hereafter.

Referring to Fig. 1, the principles of how an equatorial type tracking platform operates is illustrated. In order for an instrument to track celestial objects, it is necessary to rotate the instrument counter to the earth's rotational axis. Such an axis exists as a virtual axis 1, with the rate of rotation of top platform 5 being equal and opposite to the earth's rotational rate. The creation of virtual axis 1 can be seen to be created by virtual bearing surfaces 2, and 3, which have their centers of curvature aligned with virtual axis 1. Only a portion of such bearing surfaces needs physically to exist. These real surfaces are the adjustable front truncated bearing plate ~~front bearing surface~~ 11, having radius 9, and rear bearing surface 12, having radius 7. Such surfaces are planar and orthogonal to virtual ~~rotational~~ axis 1. Fixed bearing rollers 4 and 8 support the real adjustable front truncated bearing plate and rear bearing surface ~~bearing surfaces~~ 11 and 12, respectively, and have their rotational axis's aligned with virtual axis 1. Angle 13 defines the necessary latitudinal angle, which the virtual ~~rotational~~ axis 1 must make with a horizontal surface. Thus for each latitude setting, the angles of ~~front bearing~~the adjustable front truncated bearing plate

11, rear bearing surface 12, and fixed bearing rollers 4 and 8 must be adjusted to match the desired latitude setting.

Referring to FIG. 2, a Poncet type equatorial platform is illustrated. The platform includes an essentially horizontal top surface 43, a base surface 46, a rear fixed pivot 42, and a front bearing surface 44. Support rollers 40 and front bearing surface 44 are at pre-defined angles based on the latitude of operation. A virtual polar axis 41 is defined as projecting thru fixed rear pivot 42 and the center of curvature of the front bearing 44. Driving rollers 40 causes the top surface 43 to rotate about virtual polar axis 41. Onto the top surface 43 is placed a telescope 15 which will likewise be caused to rotate about virtual polar axis 41. A disadvantage of this design is the need to pre-manufacture the fixed bearing surfaces to the user latitude.

A similar platform is disclosed by d'Autume in USP 5,062,699. The top platform is attached to projected conical track ~~conical~~ elements in contact with horizontal support rollers, plus a rear track element~~-~~. The virtual polar axis is inclined due to the differing radii of the front and rear track elements as with the Poncet design above. A similar disadvantage of this design is the need to pre-manufacture the fixed bearing surfaces to the user latitude.

Figure 5 illustrates an important innovation of the present invention. In order to achieve different latitudinal angles of a virtual rotational axis, at least one bearing surface must have a changeable radius. View –A– of ~~figure 1~~Fig. 3 indicates a family of curves or bearing contours 20-24 which can be projected onto a small fixed curvature 25. Thus, different radii are achieved as a function of contact angle with small fixed curvature ~~contour segment~~ 25. View –B– ~~shows~~is a side projection, showing the greatest radius 20 when angle with respect to vertical is zero. Increasing clockwise angle corresponds 1:1 with latitude. Thus, bearing contour 20~~2C~~ corresponds with 0 degrees latitude, or equatorial locations. Bearing contour 23 corresponds with latitudes of 45 degrees, and so forth. A family of such contours as a function of latitudinal angle is easily described by the following equation:

Equation 1: $r_j = A + B*\sin(j)$

Where: A = front bearing radius, j = latitude angle, B = horizontal spacing between front and rear bearing surfaces, and $r_j$ = radius of rear bearing contours. Thus, a continuous and smoothly varying surface can be fabricated as illustrated in Figure 4. ~~Vertical~~ Bearing contour 20 of Fig~~ure~~. 3 corresponds to a vertical front face ~~20~~ of bearing block 27 of Figure 4. Rear bearing block 27 only needs to replicate a small portion of the curves of Figure 3. This is apparent by referring to Figure 1, showing only a portion of contour 3 needs expression as rear bearing ~~element~~ surface 12. As will be seen in later

figures, the expression of which contour will define the effective rear-bearing radius is a function of the angle of rear rolling bearings in contact with rear bearing block

Figure 5 is a perspective view of an equatorial platform according to the present inventor's initial invention. Adjustable front truncated bearing plate surface 11 has sufficient radius to ensure that the virtual polar axis which passes thru its center of curvature is located at a higher elevation than the center of gravity of the telescope placed upon it. This adjustable front truncated bearing plate ~~front bearing surface segment~~ 11 is cylindrical, of fixed thickness, and rides in two grooved drive rollers 4 spaced sufficiently apart to provide lateral support stability. One or both rollers 4 can be motorized so as to impart a rotational translation to the front bearing plate solely by friction. The front bearing plate is attached to a somewhat horizontal top platform surface 5 by means of ~~an~~ adjustable hinge assemblies 32 which can be clamped by known methods at a user defined acute angle. The drive rollers 4 are carried on adjustable hinge assemblies 30, and is likewise adjustably hinged and clamped to a bottom horizontal base surface 33. This bottom horizontal base surface 33 resides on the ground. A rear 3-dimensionally contoured bearing 27 is spaced some defined distance B from the adjustable front truncated bearing plate ~~front truncated bearing plate~~ 11. The variable B represents this distance from equation 1. Rear contoured bearing 27 is securely fastened to the underside of the top platform surface 5. This contoured bearing surface has machined into it a plurality of differing radii which are a function of the contact angle of a single or pair of rear support rollers, this contact

angle being set by a hinged rear roller mounting bracket ~~8~~ 14 mounted to the bottom horizontal base surface 5. For northern hemisphere installations, the adjustable front truncated bearing plate ~~front bearing surface~~ 11 faces north. For southern hemisphere installations, it faces south, and the drive roller rotation 4 is reversed. In both cases, all hinge angles associated with the adjustable hinge assemblies 30, 32,and ~~8~~ 14 are adjusted to align the virtual rotational axis of the platform with the earth's rotational axis.

Figure 6A shows a side view projection for a latitude of near zero degrees, showing rear fixed bearing roller 8 in a vertical orientation and contacting nearly surface contour 20 of rear bearing block 27. Thus, as predicted by equation I, radius 7 equals radius 9, thus the virtual rotational axis 1 must be nearly zero degrees, or horizontal.

Figure 6B shows a side view projection for latitude of nearly 45 degrees. Thus, the adjustable hinge assemblies ~~adjustable hinge elements~~ 30 and 31 are adjusted from the vertical zero degree position by the angle displacement equal to the latitude of operation, while front the adjustable hinge assembly ~~bearing hinge~~ 32 is clamped at an acute angle equal to 90 degrees plus the latitude angle of operation. Thus, rear fixed bearing roller 8 contacts a smaller radius of engagement machined into rear bearing block 27. This adjustment has the net effect of creating an effective radius 7, which causes the virtual rotational axis 1 to match the latitude angle. Also it can be seen that radii 9 and 7 meet the precondition that they are orthogonal to the virtual rotational axis 1.a bearing block similar to the rear bearing block 27, thus eliminating one angle adjustment by the user. By machining into its contour a fixed and constant radius as a function of latitude contact angle, operation will be identical to that described for figure 5. By machining into its contour a variable radius as a function of latitude contact angle, significantly more degrees of freedom would allow for precise positioning of the virtual rotational axis to coincide

with the center of gravity of any telescope placed upon it, thus improving the rotational balance of the system and reducing the power required to drive it.

It can also be seen by inspection of figures 5 and 6, which the adjustable front truncated bearing plate ~~adjustable front bearing surface~~ 11 could be easily replaced by

Thus there has been described an invention which allows for adjustment of elements to allow operation of an equatorial tracking platform at any latitude angle. Having described my invention, many modifications will become apparent to those skilled in the art to which it pertains without deviation from the spirit of the invention as defined by the scope of the appended claims.